

22. Report on Entozoa collected from Animals which died in the Zoological Gardens of London during Eight Months of 1919-1920. By G. M. VEVERS, M.R.C.S., L.R.C.P., F.Z.S., Beit Memorial Research Fellow, Demonstrator in Helminthology at the London School of Tropical Medicine, and Honorary Parasitologist to the Zoological Society of London.

[Received June 1, 1920 : Read June 1, 1920.]

During the past eight months I have made an attempt to examine systematically for Entozoa all animals dying in the Gardens, and have attended post-mortem examinations of four hundred animals for this purpose.

Before the body was actually opened, a microscopical examination of the faeces was made, whenever practicable, for ova and embryos of Entozoa which would give some indication of the parasites harboured, and would direct attention to the particular regions for special search.

Whether this preliminary investigation gave a positive or negative result, a subsequent search of all organs was carried out.

I have also applied this method of diagnosis to living animals in the Gardens, and these examinations have in some cases given positive results. On the death of the animal the diagnosis has been confirmed by the discovery of the adult parasites; for example, the Cylichnostomes recorded from the Grevy's Zebra in the accompanying chart were detected in this manner.

Of the four hundred animals examined 76 or 19 per cent. were found to harbour parasites.

The Entozoa found fall into the following Phyla and Classes :—

		Number of Species found.	Percentage.
PLATYHELMIA.	{ Cestoda	15	21·40
	{ Trematoda	7	10·00
NEMATHELMIA.	{ Nematoda	45	64·40
	{ Acanthocephala	3	4·20
Total		70	100·00

In all cases of Nematoda and Acanthocephala there was a preponderance of female forms. In four cases females only were found. There were 13 animals which harboured more than one species of parasite. In a Leopard Cat (*Felis bengalensis*) as many as five different species were found.

The material afforded a valuable opportunity of determining

the length of life of parasites of various groups in their hosts. Very little reliable information has been gathered on this important point. The evidence given by the incidence of parasites which have intermediary hosts is, of course, more trustworthy than that of forms which have a simple life-cycle. In the latter, infection is accumulative, and may either be acquired in the paddock or be brought into the Gardens on food: thus nine examples of *Gastrodiscus agyptiacus* were found in a Grevy's Zebra which had been in the Gardens for six years. This parasite normally occurs in Africa, and requires as an intermediary host a freshwater mollusc (*Cleopatra bulimoides*) which has not been recorded from Europe. There can be no doubt, then, that the specimens found had actually lived in the Zebra since it came from Africa, and were, therefore, over six years old.

In the same Zebra were a number of species of Bursate Nematodes, some of which have been recorded both from Africa and Europe. The life-cycle here is a simple one. That it is not possible to draw trustworthy conclusions in such a case is well illustrated by the findings in an Onager (*Equus onager*) which died quite recently. A number of the same species of parasites which occurred in the Zebra were found in this Onager, which had been born in the Gardens.

Two of the species of Cylichnostomes in the Grevy's Zebra had not been previously recorded, and it is possible that these were originally imported, but the infection may have been renewed in the paddocks. In this connection it is noteworthy that a Chapman's Zebra which died last year, after nine years in the Gardens, had only species of Bursate Nematodes which occur in European Horses.

We have, as another example of the contaminative group which might accumulate in the Gardens, an apparently unrecorded species of *Atractis* in the Elephant. Many specimens of this Nematode were found in the Indian Elephant which died in December last and which had been in the Gardens for twelve years. Recent examination of the faeces of the Elephant living in the next paddock showed that this one also is heavily infected.

The minute but fully mature females of *Atractis* are passed from time to time in the faeces, and these contain embryos so far advanced as to have the adult form. If these embryos are discharged by the mother worm in the intestine of the host, it is conceivable that they might attain sexual maturity almost immediately, and would then provide an exception to the general rule that parasitic worms do not produce a second generation of adult forms within the body of their definitive host.

The following points of especial interest were noted in individual species of Parasites:—

Two specimens of *Gnathostoma spinigerum* were obtained from the stomach of a Leopard Cat (*Felis bengalensis*). A dissection of the head-parts of a still living worm showed that the neck-glands are hollow and contractile, and contain a fluid which plays

a part in altering the size of the head, thus supporting the view, as to the function of the "ballonets," recently put forward in a paper read before this Society by Baylis and Lane*.

A microscopical examination of the fæces of the same Leopard Cat showed many minute Nematode embryos. A similar examination of the stomach contents gave the same result, but no adults could be found in this or any other of the neighbouring organs. However, in the mucosa of the œsophagus and nasopharynx the same embryos were present, but here each was coiled up in an exceedingly thin membranous shell. The presence of these viviparous eggs in the nasopharynx led to the discovery of the adult worms in a most unusual position, for the frontal sinus was next explored, and here large numbers of a species of *Synthetocaulus* were found. So far as we have been able to ascertain, this species is new to science, but it is closely allied to *S. rufescens*, which occurs occasionally in the lungs and air-passages of the Sheep in Europe.

It is of interest to note that for some time before death the animal suffered from "fits" and was often seen to lose its balance and fall. These "fits," and loss of equilibrium were no doubt due to the presence of *Synthetocaulus* in the frontal sinus.

Further examination of the fæces from the same animal showed many Trematode ova, which were recognized as those of *Paragonimus westermanni*. The lungs were then searched, and four specimens of the adult fluke found. The number of eggs in the fæces was exceedingly large considering the few adults which gave rise to them.

I am indebted to Professor R. T. Leiper for his invaluable assistance and advice on a number of the more intricate points arising in the course of the above inquiry.

List of Parasites found, with their Hosts.

TREMATODA.

<i>Genus.</i>	<i>Species.</i>	<i>Host.</i>	<i>Length of time in Gardens.</i>
†Gastrodiscus	egyptiacus (Cobbold, 1876). Railliet, 1898.	Grevy's Zebra. (Africa.)	6 years.
†Notocotyle	triserialis (Diesing, 1839). Diesing, 1850.	(2) Netta rufiga. (India.)	1 week.
Paragonimus	westermanni (Leuckart, 1889). Stiles, 1900.	Felis bengalensis. (India.)	6 months.
Platynosoma	illiciens (Braun, 1901). Looss, 1907.	Rhaphistos erythrorhynchus. (S. America.)	3 months.

* P. Z. S. 1920, p. 245.

† Denotes that this Parasite has not been recorded before from this Host.

<i>Genus.</i>	<i>Species.</i>	<i>Host.</i>	<i>Length of time in Gardens.</i>
†Ochetosoma	formosum Nicol, 1911.	Zamenis flagelliformis. (S. America.)	7 months.
Macrodera	naja (Rud. 1819). Looss, 1899.	Tropidonotus natrix. (Britain.)	5 months.

CESTODA.

Cyclophyllidea.

Tania	crassicolis Rud. 1810.	Genetta genetta. (Spain.)	6 months.
Davainea	goura Fuhrmann, 1909.	Goura coronata. (New Guinea.)	1 week.
Davainea	paucitesticulata Fuhrmann, 1909.	(2) Calenas nicobarica. (Nicobar Islands.)	6 months.
Davainea	sp. inq.	Fringilla coelebs. (Britain.)	?
Davainea	sp. inq.	Schizorhis concolor. (S. Africa.)	3 months.
Davainea	sp. inq.	Caccabis elukar. (Syria.)	10 months.
Davainea	sp. nov.	Casuarius uniappendiculatus. (New Guinea.)	6 months.
Davainea	sp. nov.	Casuarius uniappendiculatus. (New Guinea.)	6 months.
Hymenolepis	villosa (Bloch, 1872). Wolffh. 1899.	Tetrax tetrax. (Britain.)	9 months.
Hymenolepis (Echinocotyle.)	sp. inq.	(4) Quelea quelea. (S. Africa.)	4 months.
Hyracotania	procaviae Beddard, 1912.	Procavia capensis. (S. Africa.)	3 months.
Ophiotaenia	sp. inq.	Crotalus atrox. (Cent. America.)	5 months.
Tetrabothrius	cylindraceus (Rud. 1819). Diesing, 1850.	(2) Larus glaucus. (Europe.)	7 years.

Pseudophyllidea.

Dibothriocephalus sp. inq.	Conepatus proteus. (Argentina.)	2 years.
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NEMATODA.

Ascaris	osculata Rud. 1819.	Otaria californiana. (North Pacific Ocean.)	6 months.
Ascaris	holoptera Rud. 1819.	(3) Testudo ibera. (S. Europe.)	1 year.
Ascaris	sp. inq.	Casarca casarca. (Europe.)	5 years.

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<i>Genus.</i>	<i>Species.</i>	<i>Host.</i>	<i>Length of time in Gardens.</i>
Ascaris	sp. inq.	Spheniscus demersus. (S. Africa.)	3 weeks.
Belascaris	mystax (Zeder, 1800). Leiper, 1907.	Felis bengalensis. (India.)	6 months.
Toxascaris	sp. inq.	Vulpes lagopus. (Syria.)	2 weeks.
Porrocaecum	crassum (Deslongchamps, 1824). Raill. et Henry, 1912.	Grus communis. (Europe.)	9 years.
Contracaecum	spiculigerum (Rud. 1819). Raill. & Henry, 1912.	Phalacrocorax carbo. (Britain.)	4 months.
Oxysomatium	brevicaudatum (Zeder, 1800).	Anguis fragilis. (Britain.)	?
Heterakis	vesicularis (Dujardin, 1845).	Phasianus torquatus. (China.)	2 weeks.
Heterakis	vesicularis (Dujardin, 1845).	Cerionis satyra. (India.)	7 years.
†Cucullanus	microcephalus (Dujardin, 1845).	Chrysema scripta rugosa. (West Indies.)	1 month.
Gnathostoma	spinigerum Owen, 1836.	Felis bengalensis. (India.)	6 months.
Ascaridia	sp. inq.	Centropus rufipennis. (India.)	10 days.
Ascaridia	lineata (Schneider, 1836).	(2) Ocyphaps lophotes. (S. Africa.)	4 years.
Physaloptera	retusa (Rud. 1819).	Tupinambis teguixin. (S. America.)	1 month.
(Eso)phagostomum	apiostomum Willach, 1891.	(7) Macacus rhesus. (India.)	18 months (approx.).
Ancylostomum	conepati Solonet, 1911.	Conepatus proteus. (Argentina.)	2 years.
Uncinaria	criniformis (Goeze, 1782).	Vulpes vulpes. (Britain.)	5 months.
Uncinaria	sp. inq.	Felis lynx. (Thibet.)	?
Hæmonchus	contortus (Rud. 1803).	Hippotragus equinus. (Africa.)	1 week.
Syngamus	bronchialis (Muhlig, 1884).	Casarca casarca. (Europe.)	5 years.
Cylichnostomum imparidentatum (Poteriostomum). Quiel.		Chapman's Zebra. (Africa.)	9 years.
†Cylichnostomum goldi Boulenger, 1916.		Chapman's Zebra. (Africa.)	„
†(Eso)phagodontus robustus Giles, 1892.		Chapman's Zebra. (Africa.)	„
†Tridontophorus intermedius Sweet, 1909.		Chapman's Zebra. (Africa.)	„

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<i>Genus.</i>	<i>Species.</i>	<i>Host.</i>	<i>Length of time in Gardens</i>
†Strongylus	edentatus Looss, 1901.	Chapman's Zebra. (Africa.)	9 years.
Strongylus	vulgaris Looss, 1901.	Chapman's Zebra.	"
†Probstmayria	vivipara Ransom, 1907.	Grevy's Zebra.	6 years.
†Cylichnostomum	nassatum var. parvum Yorke & Macfie, 1918.	Grevy's Zebra.	"
Strongylus	vulgaris Looss, 1901.	Grevy's Zebra.	"
Strongyloides	intestinalis Grassi, 1883.	Felis bengalensis. (India.)	6 months.
Synthetocaulus	sp. inq.	Felis bengalensis. (India.)	"
Oxyuris	equi Schrank, 1788.	Chapman's Zebra. (Africa.)	9 years.
Oxyuris	longicollis Schneider, 1866.	Testudo graeca. (Europe.)	6 months.
Filaria	gracilis Dujardin, 1845.	Ateles griseus. (S. America.)	2 months.
Setaria	sp. inq.	Hippotragus equinus. (East Africa.)	1 week.
Diplotriana	tricuspis (Fedschenko, 1879). Raill. & Henry, 1909.	Acridotheres ginginianus. (India.)	?
Trichocephalus	affinis Rud. 1801.	Ovis vignei. (India.)	6 years.
Trichocephalus	dispar Rud. 1801.	Macacus rhesus. (India.)	18 months (approx.).
Dispharagus	squamatus (v. Linstow, 1883).	Phalacrocorax carbo. (Britain.)	4 months.
†Atractis	sp. nov.	Elephas indicus. (India.)	12 years.

ACANTHOCEPHALA.

Echinorhynchus	claviceps.	Chrysema scripta rugosa. (America.)	1 month.
(Echinorhynchus)	sp. inq. gen. inq.	Callicebus moloch. (S. America.)	"
(Echinorhynchus)	sp. inq. gen. inq.	Leontocbus ursulus. (S. America.)	3 weeks.

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